DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
2098 Gaither Road
Rockville MD 20850

JUN - 6 1996

TO: All Holders of Approved Variances for Laser Light Shows and Displays.

SUBJECT: Effective Visual Control of Laser Projections.

BACKGROUND:

All variances issued by the Food and Drug Administration (FDA) for laser light shows contain the following condition in Attachment A of the variance:

> "All laser light shows shall be under the direct and personal control of a trained, competent operator(s). The operator(s) shall:
>
> (a) be an employee of the variance holder who shall be responsible for the training and conduct of the operator;
>
> (b) be located where all beam paths can be directly observed at all times; and
>
> (c) immediately terminate the emission of light show radiation in the event of any unsafe condition and, for open air shows, at the request of any air traffic control officials."

The requirements of clauses (b) and (c), that the operator shall be located where all beam paths can be directly observed at all times and that laser emissions can be terminated in the event of any unsafe condition, are basic principles for effective visual control. These general principles have usually been sufficient when applied to laser light shows or displays with limited projection ranges such as indoor displays where the projection paths do not extend beyond the range of effective visual control.

However, in the case of outdoor laser light shows and displays, unterminated projections into airspace may be used. While one may be able to look along the direction of a beam path, the operator can only see objects effectively for a limited distance.

POLICY:

Effective immediately, the requirements in clauses (b) and (c) of the above condition are interpreted more specifically to require that the operator have effective visual control of all the beam paths at all ranges for which the laser emission levels are a hazard for injury to the eye or for major temporary visual impairment such as flashblindness.

The FDA, in consultation with the Federal Aviation Administration (FAA), the industry, and other interested parties has determined that the reasonable range of effectiveness for visual aircraft observers to spot small, minimally lit planes or helicopters in clear air and the conditions typically encountered in outdoor laser light show operations is three miles horizontal range from the laser projector. This is the range of effective visual control for aircraft observers. FDA has further determined that projection of laser emission levels which are capable of producing flash-blindness beyond the range of effective visual control for the means used to detect approaching aircraft is inconsistent with the variance requirements cited above.

The FAA accepts, as a requirement for the Sensitive Flight Zone, a Sensitive Zone Exposure Limit (SZEL) of 100 $\mu W/cm^2$ maximum irradiance (equivalent to 25 $\mu J/cm^2$ maximum radiant exposure in one quarter second or less). This is published in the FAA Order (FAAO) "Procedures for Handling Airspace Matters," 7400.2D Change 1, used in aeronautical studies of proposed entertainment and advertisement outdoor laser operations submitted to the FAA. This limit is intended to protect against flashblindness.

Therefore, laser beams projected into navigable airspace shall not have an irradiance or radiant exposure in excess of the SZEL (100 $\mu W/cm^2$ or 25 $\mu J/cm^2$) at horizontal ranges in excess of the reasonable range of effectiveness for the means used to detect possible aircraft intrusions into the projection space.

We understand that this may limit the beam power and/or require a MINIMUM beam divergence to be implemented.

It should be understood that assuring compliance with the SZEL makes the determination of minimum beam divergence and maximum beam power critical determinations in the assurance that the laser show or display is in compliance with the conditions of the variance. Other parameters such as pointing accuracy, minimum required scanning specifications, and adequate scanning safeguards (when applicable) are also significant for assuring compliance. We will advise the industry if we become aware of any additional elements that are needed. These determinations shall be made using well documented and defensible test procedures. Accurate and timely measurements and recordkeeping are also essential parts of the manufacturer's testing program which is in accordance with good manufacturing practices. Skilled engineers and/or technicians may be necessary to perform these tasks.

Measurements of beam characteristics must clearly identify whether beam diameter and divergence are determined using 1/e- or $1/e^2$-values. Whichever value may be reported, the 1/e-divergence value shall be used to determine that the irradiance limit is not exceeded.

The FDA has been engaged in meetings with other Federal and local agencies, the military, and concerned industries. These meetings have resulted in the dissemination of interim guidance, the Recommended Interim Guidelines (RIGS), which were adopted by the FAA and issued in their Order 7400.2D; Change 1, effective March 11, 1996. These guidelines are intended to prevent ocular injury and also to prevent temporary visual impairment due to flashblinding, dazzle, or glare.

The conditions given by this notice more specifically define requirements that are already implicit in all currently approved variances.

I am sure that you share our concern for the flight safety of the public. We must all do our parts to prevent the occurrence of a tragedy that could cost hundreds of lives. Be advised that the primary responsibility for the safety of a laser display belongs to the manufacturer/operator of the display. It is that party's responsibility to be in control of the quality and safety of the projections and to be sure that the equipment is operated in accordance with the conditions of their variance and in compliance with all applicable guidelines for safety.

Please recognize that the policy guidance in FAAO 7400.2D is subject to change as the science develops or as events require the disemination of new information for the prevention of future incidents involving visual impairment of aviators. We are confident that you will receive this notification in a spirit of cooperation and commitment to public safety.

Lillian J. Gill

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Director
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